WRD COLLEAGUE REVIEW WORKSHOP GUIDE

by Perry G. Olcott

U.S. GEOLOGICAL SURVEY
Water Resources Division
Open-File Report 85—633

WATER RESOURCES DIVISION

COLLEAGUE REVIEW WORKSHOP GUIDE

For additional information
write to:
Scientific Publications Section, SP&DM
439 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

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INTRODUCTION

The written report documents and disseminates the results of nearly every aspect of Survey activity and fulfills the mandate to promptly make public results of all investigations. The excellence of Water Resources Division reports consequently not only affects the success of information transfer but is a principal aspect on which the Survey is judged by the scientific community and the public. It is incumbent upon authors, together with District or Research Project supervisors, discipline specialists, and reports-processing staff to produce technically accurate and cogent reports. An integral part of this process is the colleague review, whereby technically competent and unbiased individuals not associated with the originating District or Research Project office carefully examine and comment on technical aspects of newly written reports as a final quality-control procedure prior to Region and Headquarters evaluation. Colleague review is the subject of this workshop. The objective of the workshop is to introduce participants to the mechanics, philosophy, principles, and techniques of colleague review. The purpose of this guide is to present procedures and guidelines for conducting a competent colleague review. This workshop guide is in outline form and is intended to supplement a formal Water Resources Division training course.

- The high standard of excellence in reports of the Geological Survey is the result of a group effort in the reports-preparation system. The technical colleague reviewer is, next to the author, the most important member of that group.

- District, Research Project, and out-of-office colleague review steps are reviews to improve and polish reports; Regional, Headquarters, and Director's Office steps are evaluations. The report-routing sheet submitted for Regional, Headquarters, and Director's approval should contain only the names of authors, technical reviewers, and supervisors. Evaluation by Regions and Headquarters includes consideration of who has reviewed the technical aspects of the report as an outside colleague. One out-of-office review is mandatory; two such reviews are recommended.

PHILOSOPHY OF COLLEAGUE REVIEW

"The purpose of the colleague review is to maintain high quality by suggesting needed technical and editorial changes that will improve the report and that will eliminate errors which may lead to the embarrassment of the author and the Survey. In addition, review should help an author improve his subsequent reports, and should acquaint him with procedures he can use himself in the review of the reports of others." (See Exhibit 1 and 2.) -- L. A. Heindl

The colleague review system--review of manuscripts by hydrologists active in the science both within and outside of the District or Research Project --is a primary function contributing to the excellence of the final publication. District and Project Chief reviews and Regional and Headquarters evaluations should only be quality controls to assure adherence to Survey policy. (Exhibit 3.)

Need for Colleague Review

- Major problems noted in reports are inadequate technical review, inadequate cross checking, and violation of Survey Policy. Editorial deficiencies also detract from reports, hinder technical clarity, and diminish the effectiveness of information transfer.

- Colleague review outside of the District or Research Project office provides an unbiased reading by a technically competent reviewer as a test of clarity, technical adequacy, and adherence to policy. This is the reason that an outside review by someone unfamiliar with the project and the report is so important in the review process.

- Approximately 40 percent of reports reaching the Regional reports advisors are returned to the originating office--most returns are for technical reasons.

- Approximately 5-10 percent of reports reaching the Scientific Publications Section are returned to the originating office because of technical problems or policy violations.

Responsibilities of Review Participants

Although the author has final responsibility for the report, each technical reviewer must share responsibility for the technical accuracy of the final report.

Responsibilities of the Author(s)

- The report should be the best product the author and originating office can produce before submitting it for colleague review.
- Reports originating in Districts should have at least two inhouse technical reviews and an editorial review by colleagues and the District Reports Specialist prior to submittal for colleague review.
- A clean copy of text, illustrations, tables, Water Resources Scientific Information Center (WRSIC) abstract, press release, and note for monthly list, as applicable, should be submitted along with a completed routing sheet for out-of-office colleague review.
- All illustrations and tables must be neat, legible, and complete.
- All colleague review comments must be acknowledged and incorporated, if accepted, or a reason given if not accepted.

Colleague reviewers should be acknowledged personnally, or by memorandum.

- All marked-up review copies must be forwarded with the manuscript to the next review or evaluation step.
- A manuscript check list should be used and adhered to. (Exhibit 4.)

Responsibility of Colleague Reviewer

- Insure technical soundness and clarity of the report and suggest alternative methods of analysis or interpretation, if appropriate.
- Devote adequate time and effort necessary to check mathematics, methods of approach, organization, soundness of conclusion, adequacy of data to support conclusions and accuracy and adequacy of illustrations, tables, and data presentation.
- Clearly indicate problems through well thought-out, legible marginal comments and a summary memorandum. Avoid derogatory or humorous comments and try to make constructive suggestions for improvement. Point out good as well as bad aspects. (Exhibit 5.)
- Maintain a positive attitude toward colleague-review duties.

Responsibilities of District Chiefs and Research Project Managers

- Become personally involved in the review process. Read the report--especially for technical and editorial adequacy and Survey policy.
- Accept reports and allow time for out-of-office colleague review by technical people in your charge.
- See to the training of hydrologists in techniques of colleague review.
- Insist on at least one out-of-office, unbiased colleague review of all technical reports produced under your supervision.
- Insist on full consideration of all review comments by authors and help monitor author responses.
- Include colleague review as part of the duties and performance standards of all professionals.

Responsibilities of Regions and Headquarters

- Evaluate reports for policy, adequacy of review, and consideration of review comments by author.
- Aid in selection of colleague reviewers.
- Encourage and support colleague-review system.
- Aid in training colleague reviewers.

Selecting a Colleague Reviewer

1. The more technical the report the more careful your choice of colleague reviewer should be.

2. Seek a hydrologist specializing in the same primary area of expertise addressed in the report. If time permits, select a nontechnical reviewer to evaluate report clarity.

3. Seek advice of supervisors and especially Regional and Branch specialists when choosing a colleague reviewer.

4. Seek a person in whom you have confidence and one who is willing to review the report.

5. Contact potential reviewers through their respective District or Research Project Chiefs by telephone and memorandum. Transmit report by registered or certified mail with a memorandum (Exhibit 6) that briefly describes the background and significant aspects of the project, any unusual aspects of the report, a date for return of the report, and the name(s) of reviewers previously agreed upon by telephone.

Types of Reviews

There are several different methods for conducting a colleague review. However, regardless of methods used, the end result should be a technically sound, understandable, and informative report of which the Survey and author will be proud. Although colleague review is primarily technical in nature, the conscientious reviewer will evaluate, spot check, and comment on all of the following aspects of the report:

1. Clarity of expression--Clear and understandable text, illustrations, and tables are necessary to convey a technical message to the intended audience. This review should preceed any technical reviews to assure clarity of technical ideas.

2. Technical--Technical accuracy and correct methodology is necessary to assure problem solving and to present a believable and practical solution to problems addressed. Proper techniques applied to suitable data is mandatory in reports.

3. Cross Check--A check of all data presented for consistency of use throughout the report will avoid ambiguity and insure the best possible support of technical interpretations.

4. Policy--A policy review will help assure adherence to the nonadvocacy and objective analysis rule established by the Survey.

Methods of Review

1. Concurrent review--Copies of report sent to all reviewers simultaneously and all comments are incorporated at one time--a savings of time.

2. Consecutive review--Report sent to one reviewer at a time with corrections made prior to next review--continual polishing.

3. Group or storyboard review--Two or more colleague reviewers that have read the report meet to discuss and revise entire report as it is presented by the author--many thoughts and new ideas generated by mutual stimulation of group and it usually saves time.

Sources of Information for the Colleague Reviewer

- Published Survey reports on the topic of the manuscript
- American Geological Institute glossary and other technical glossaries, and dictionaries
- Techniques of Water-Resources Investigations
- Water Resources Division Publications Guide
- Government Printing Office Style Manual
- Suggestions to Authors of the Reports of the United States Geological Survey (5th and 6th editions)
- Division, Branch, and Regional technical and policy memorandums
- Branch, Regional, and District discipline and report specialists
- Colleagues
- Scientific Publications Section, Scientific Publications and Data Management (SP&DM)

PRINCIPLES OF COLLEAGUE REVIEW

Effective colleague review is a systematic check of salient features in each report. Individuals may differ in their approach to colleague review but each should look for the specific features that make up an excellent report. What are the characteristics of a well-written, technically sound report? First and foremost, the report presents a logical train of thought that is indicated in the title, proposed in the Introduction, defined by the Purpose and Scope, developed throughout the body of the report, and summarized in the Summary and/or Conclusions. The report is technically accurate and it conforms to Survey policy. The illustrations and tables are clear, meaningful, and integrated with the text. The writing is clear and concise and avoids jargon.

Review of Report Organization

Although colleague review primarily is concerned with technical accuracy, the organization of the report is vitally important in transferring information to the reader and should be examined by the colleague reviewer. The report should exhibit a logical development of thought.

- Title accurately reflects report content, and, if applicable, describes time and location of study.
- Table of contents reflects title, purpose and scope, and introduction and body of report and presents a logical organization for the material presented. (Exhibit 7.)

- Abstract summarizes findings of report and addresses subject identified in title, introduction, and purpose. (Exhibit 10)

- Introduction describes the problem to be addressed in sufficient detail, briefly describes the physical setting, and includes an accurate purpose and scope that reflects the title. (Exhibit 11)

- The body of the report varies with subject but reflects the title; the conclusions are adequately supported by the data and address the problem(s) specified in the introduction.

- The summary or conclusions reiterate or summarize only those conclusions mentioned in the text (no new material) and specifically answer the purpose(s) of the report. (Exhibit 14)

Class exercise on report organization

Review for Technical Accuracy

- Methods used are appropriate to the problem and the purpose and scope of the report and alternatives are considered.

- Methods are clearly described.

- Data are adequate to support methods and conclusions.

- o Methods and findings adequately support conclusions.
- o Conclusions are properly qualified and, if applicable, alternatives are proposed.
- o Illustrations and tables will stand by themselves. They are legible, logical, present the data without bias, and all interpretations (such as contours) are reasonable.
- o Data used are as current as possible and different data sets are equivalent in accuracy and time if used for comparison.
- o Rules of significant figures are observed.
- o All aspects of the purpose(s) of the report are considered.
- o The text, illustrations, and tables are mutually supportive; all illustrations and tables are discussed in the text.
- o The literature has been reviewed, and is referenced, and accurately cited.

Class exercise on technical review

Review for Survey Policy

- o No distinction in technical and editorial quality should be made between the different series of reports.
- o The report is appropriate for the intended publications series. (Exhibit 8 and 9).

- Impartiality, objectivity, and integrity are maintained.
- Notification of availability of a report should be given to all at the same time.
- All sources of information are acknowledged and all references documented.
- Cooperators are acknowledged.
- Written permission to publish any copyrighted material has been obtained from author and(or) publisher and is included.
- Report does not make recommendations; words such as recommend, ought to, must, and should, are not used.
- Conclusions of report are logical, unbiased and technically sound, and alternatives are proposed if appropriate.
- Report content does not encroach upon the private sector. Consulting type statements such as; "wells should be placed in spot x to obtain y gallons yield," are avoided.
- Affiliation of non-Survey author(s) is documented.
- Role of significant contributors is acknowledged.
- Report (including text, illustrations, and tables) follows formats specified in the Water Resources Division (WRD) Publications Guide and Government Printing Office (GPO) Style Manual.

- Disclaimer statement is included for any mention of brand, firm, or commercial trade name.

- No criticisms are made or blame assigned.

Review for Clarity (Verification Review)

- Values and terminology used in more than one place in text, illustrations, and tables, must be the same and are spot-checked for consistancy.

- Abstract, conclusions, purpose and scope, and body of report are spot checked for contradictory statements; information presented in WRSIC abstract and press release, if applicable, agrees with report.

- Report title and authorship, cooperative statement (if applicable) cover, title page, introduction, WRSIC abstract, and news release, are consistent.

- Rank and wording of section headings are correct and agree with table of contents.

Review for Type of Publication

- Factors in selecting proper outlet for Water Resources Division-prepared reports.

- Decision trees for book and map reports. (Exhibits 8 and 9.)

Review of Illustrations

- Are illustrations reviewed?
- Are the illustrations needed?
- Could the data be presented in a more appropriate or understandable manner?
- Are the data shown on the illustration accurate?
  - -- Comparison with statements in text.
  - -- Comparison with data in tables (if available).
- Are the illustrations prepared correctly?
  - -- Maps and explanations
  - -- Graphs
  - -- Photographs
  - -- Other illustrations
- Is the format appropriate for the publication medium?
- Is the format consistent among similar illustrations?

Class exercise on illustrations

TECHNIQUES FOR COLLEAGUE REVIEW

Adopt a system or procedure of review and follow it. Each reviewer should use what works best for him or her. The following procedures are suggested as a starting point.

Procedures for Colleague Review

Step 1: Acquaint yourself with the report and any pertinent background information.

Scan the report for:

- o appropriateness of title
- o content and emphasis (abstract) (Exhibit 10)
- o the problem addressed (Exhibit 11)
- o organization (table of contents) (Exhibit 7)
- o purpose and scope (Exhibit 12)
- o method of approach (Exhibit 13)
- o illustrations and tables used
- o conclusions reached (Exhibit 14)
- o writing style and editorial adequacy
- o the emphasis of report

Step 2: Study table of contents:

Is the organization of report logical and does it exhibit continuity of thought? (Exhibit 7)

- o Do first order headings reflect title and main theme of report?
- o Subdivided headings have 2 or more subheadings?
- o Headings are subdivided appropriately and logically?

Step 3: Study the introduction. (See Exhibit 11)

a. Is the problem clearly defined and does it:

- o reflect the title of report
- o reflect the organization (table of contents)
- o adequately address the purpose, scope, and methods of approach
- o present the main theme and emphasis of report

b. Is the purpose and scope: (See Exhibit 12)

- o clearly defined
- o technically appropriate to the problem
- o answered, step by step, by the conclusions

- o a good indicator of the theme and emphasis of the report
- o appropriate to the title of report

c. Are the methods of approach clearly stated, and are the methods appropriate to the problem and to the purpose and scope? (Exhibit 13)

d. Is an appropriate description of the physical setting of the project area given?

- o Only information given is that necessary to a general understanding of the area and of data that will be used in calculations in body of report.

e. Has literature review been conducted and is past work properly acknowledged?

f. Has recognition been made of help or information given by individuals (especially those of cooperating agencies) in an acknowledgements section? (Exhibit 15)

Step 4: Study the body of the report:

a. Are data:

- o complete and appropriate to problem
- o of uniform quality and accuracy

- o current and for the same time periods if used in comparison
- o adequate to support methods of interpretation and conclusions reached
- o properly qualified, presented, and referenced where appropriate

b. Are mathematical and chemical equations and formulas accurate, clearly presented, properly referenced, and appropriate to the problem and the supporting data?

c. Is work a new contribution to the science or a reinvention of the wheel? (Is technical content appropriate for publication?)

d. Are the illustrations and tables clear, concise, and technically accurate? Will they stand by themselves and are they adequately discussed and effectively used in text? Are illustrations and tables taken from published work properly referenced, and, if copyrighted, has written permission to reprint been obtained from the holder of the copyright?

e. Does a spot check between text, tables, and illustrations show any discrepancies?

f. Is the discussion logically developed and directed as indicated in table of contents? Is the emphasis on the main theme of the report as established in the title and purpose and scope?

g. Are methods subservient to theme of report? For example, is the model emphasized at the expense of the interpretive findings in a study that uses a model as a principal analytical tool?

h. Is a logical argument supported by adequate data, developed to answer the problem and the purpose and scope of the report and properly summarized in conclusion?

Step 5: Study the conclusions of the report: (Exhibit 14)

a. Do the conclusions answer the purpose of the report?

b. Are the conclusions a logical outgrowth of the arguments developed in the body of the report and are they free of information that was not mentioned in the body of the report?

c. Do the conclusions culminate the theme indicated in the report title, defined in the purpose and scope, and developed in the body of the report?

Step 6: Reexamine report for:

a. Survey policy violations

b. Logical organization

c. Readability and content for intended audience

d. Appropriateness of title (title should indicate report content and, if appropriate, describe location and time frame of study).

Step 7: Communicate your findings back to author:

a. Telephone discussion (suggested)

b. Marginal comments (mandatory)

c. Written summary comments (mandatory) (Exhibit 5)

d. Memorandum of transmittal back to author (mandatory)

Class exercise on report review

Quality of Colleague Review

Need for Adequate Colleague Review

- Improved technology requires more detailed review.
- Colleague review commonly is the only technical review.
- We need to upgrade quality of Survey reports.

Present Problems with Colleague Review System

- Many reports do not receive unbiased colleague review outside of the authors immediate work area.
- The number of reports requiring reviews places a strain on the time of recognized, competent colleague reviewers but many competent people are never asked.
- Colleague review received is often inadequate or inappropriate.
- Reviewers commonly are selected more on basis of availability than on competence.
- Many authors do not give ample attention to reviewers' comments.

- There is a tendency to pass on the responsibility for establishing excellence to the next review or evaluation step rather than demanding excellence at each level. Director's approval is valued more than excellence of the product by many authors and supervisors.

- There is a prevailing attitude that small or nonsignificant reports do not need a thorough competent review.

Methods of Improving Colleague Review

- The need for and importance of colleague review must be emphasized.

- Educate reviewers that their task is a vital service.

- Train hydrologists early in their career in philosophy and techniques of colleague review.

- Educate supervisors and managers at all levels that excellence of reports is of greatest priority.

- District or Research Project offices that do not have a technical editor (or equivalent) should seek editorial review outside of the District or Research Project Office through the Regional office.

- Ultimately, the success of colleague reviews and the production of high-quality reports depends on the involvement, support, and close supervision of the entire report-preparation and review process by District Chiefs, Research Project Chiefs, and other principal supervisors.

SUMMARY AND EVALUATION OF COURSE

Discussion of Course Content

Written Class Evaluation

SUGGESTIONS TO REVIEWERS

By L. A. Heindl

(Geologist, Office of the Area Hydrologist, ACA, Arlington, Va.)

INTRODUCTION

The Water Resources Division's report-improvement program was initiated to fill the breach left by the elimination of the old Branch Review Sections. With those sections gone, the full weight of responsibility for the quality of our reports was shifted back to the districts--particularly to the District Chiefs or District Supervisors, and to the authors. Simultaneously, the Division realized that with the disbandment of the Review Sections, the districts would need assistance to develop techniques and habits that would help them turn out reports at least equal to the quality of those the districts prepared with the aid of the Review Sections. The report-improvement program represents the Division effort in this regard, and this discussion of techniques of review is a part of this effort.

The report-improvement program initially had--and still has--one principal goal: to improve our reports. The program is working towards this goal along several different lines concurrently--through various training devices, improvement of report-planning techniques, assistance to districts and authors during preparation stages, salvage of completed but inadequate reports, and through facilitated communication between all individuals and sections dealing directly with reports. To implement the program, each Area Hydrologist has a Staff Assistant for report improvement, and each district has--or will have shortly--at least one specially trained Reports Specialist or Reports Advisor.

The process basic to the improvement of reports is review to insure that they meet certain standards of content, style, and format. "Suggestions to Authors" puts review in the framework of the Survey's responsibilities: "The Survey generally exercises its proprietary interest only to the extent of seeing that a report is scientifically and technically sound, will reach the proper audience, and will reflect credit on both the Survey and the author. To these ends, each report is reviewed by the author's fellow workers, supervisors, and staff officials, who bring to bear upon it their specialized knowledge, skill, and judgment to assure a sound product. In its final form each Survey report is the product of team effort in which many persons do their share--even though most of them remain anonymous." Thus, review in the Survey includes critical evaluation of the technical content and the editorial quality of the text, illustrations, and tables, and of the proposed medium of publication.

Because review involves both technical content and editorial quality, and because opinions on editorial quality are always somewhat subjective, the questions of how far editorial review should go and how to distinguish between technical and editorial review are frequently argued among--and between--reviewers and authors. In practice, however, the two are closely related, as described in the following quotation from "Suggestions to Critics," a pamphlet issued in 1949 by the Geologic Division.

"The quality of any scientific manuscript is a function of two commonly unrelated variables--the quality of the research, and the effectiveness of the presentation. The criticism of a manuscript is an equally two-sided problem--examining the soundness of the data, reasoning, and conclusions (reviewing); and helping the author to transmit his ideas into the mind of the reader with a minimum of distortion (one definition of editing). Everyone agrees that the critic's chief duty is to review, in the sense above defined. *** Such editing as the critic feels impelled to do *** should make it possible for the average, even nongeologic, reader to understand what the author is trying to say. *** If editing is defined as making 'more intelligible,' this function is legitimate and should be one of the duties of the critic ***."

The close relationship is put more bluntly by the semanticist, Wendell Johnson: "***clarity is a prerequisite to validity***. (Writing) can be clear without having validity, but if it is unclear its validity cannot well be determined."

For our purposes, editorial review is limited largely to making a report grammatically correct; it includes attention to details such as spelling, punctuation, and word order, and more importantly, to clarity, syntax, and the proper use of words. When done by nonprofessional colleagues, it can be valuable for suggestions as to how to clarify and simplify technical explanation in a report intended for nontechnical readers. But in general, editorial review is mostly a mechanical application of the customs of good English usage and typographical style appropriate to the publication medium. By and large, editorial review should be completed before a report is submitted for technical review.

Technical review, in contrast, has the broader responsibility of making certain that the report is technically sound and will reach and be clear to its intended audience. Consequently it involves attention

to the validity of both the technical data and its use, to the effectiveness of the organization, and to the clarity of its presentation of the material. Thus technical review includes many editorial functions. These editorial functions, however, should supplement and refine what is already an editorially adequate manuscript.

But how does one review? What is a good report? How does one assure a "sound product"? How does one know that a reviewer has been effective? These questions, and others, are discussed in this summary of review practices, which also recapitulates principles, outlines some techniques, and offers a few criteria for reviewing reports and for evaluating their review.

What Is a Good Report?

A good report, first and most importantly, has something to say to the intended reader. To do this it must be presented at a level of explanation suitable to the intended reader and in the proper publication medium. Other characteristics of a good report are outlined below in the general order of importance:

1. It is technically sound.

2. It is well organized.
   a. The title indicates clearly the subject.
   b. The purpose is expressed clearly and explicitly.
   c. The data are pertinent to the purpose.
   d. The reasoning by which the interpretations and conclusions are reached are given adequately and clearly.
   e. The conclusions are valid.
   f. The important factors are properly emphasized and supporting factors are subordinated.

3. It is timely.

4. It is brief, consistent with soundness and clarity.

5. It is attractive.

When Is a Manuscript Ready for Review?

A manuscript is ready for review when an author has done everything possible to make it meet generally accepted standards of technical soundness and editorial adequacy. This implies that he has taken an objective view of the report, made it a rational development of and contribution to the current state of knowledge in its field, and made all the mechanical checks necessary to make the text, tables, and illustrations accurate and mutually consistent. In addition, the manuscript presented for review should be reasonably clean and clear, and it should be accompanied by the background information that is pertinent to the review, including previous reviewers' comments or a digest of them.

PRINCIPLES OF REVIEW

Purpose

The purpose of review is to maintain high quality by suggesting needed technical and editorial changes that will improve the report and that will eliminate errors which may lead to the embarrassment of the author and the Survey. In addition, review should help an author improve his subsequent reports, and should acquaint him with procedures he can use himself in the review of the reports of others.

Qualifications of Reviewers

Reviewers should be, as "Suggestions to Authors" puts it, "specially qualified by their knowledge of, and interest in, the problems discussed." These certainly are the main prerequisites. But they also should have the confidence to pass judgment on the quality and validity of a report, and to point out deficiencies and suggest improvement. They should remember that their principal objective is to improve the report, and they should do this willingly. Their attitude towards a report should be objective, but nonetheless careful and considerate. Perhaps the attitude is best summed up by the term used somewhere by Robert Louis Stevenson, "respectfully skeptical." In addition, a reviewer should be able to state his opinions clearly, be firm but tactful, and to be willing to accept responsibility for his suggestions. Last but not least, his comments should be legible.

Responsibilities of Reviewers

All professionals are expected to make a certain amount of time available and to assume responsibility for critically reviewing and discussing a colleague's reports as a normal part of their duties. As a reviewer, the professional's first responsibility is to assure the technical soundness of the report. To do this best, all suggested changes should be constructive and specific, and the reviewer should give reasons for and be prepared to justify his suggestions. He should keep in mind the purpose of the report and whether the report will fulfill its purpose. He, of course, has the responsibility of being professionally honest, regardless of how considerate he may wish to be personally. As far as possible, he should leave the author's "style" alone, commensurate with accuracy, clarity, and brevity.

Amount of Review

The amount of review needed by a report will depend on the quality of the report. Probably it is not so much a matter of how much review as of how thorough are the reviewers. In general, a report can benefit from comments made by several technical reviewers, and certainly each report should have at least enough objective review to assure its technical soundness and editorial clarity. If a technical reviewer spots major faults in a report, such as misuse of basic concepts, he should note these and return the report to the author without spending time on details. A report may need editorial review twice--once, when it is the author's final draft; and again, after it has been revised following the final technical review.

Alternate Methods of Review

Review may be concurrent or consecutive. That is, a number of copies may be sent out to several reviewers simultaneously, or one copy may be sent to several reviewers in turn. The advantage of concurrent

review is that it is faster, and the author has an opportunity to compare different reviewers' comments before making his revision; the main disadvantages are that the author may be faced with conflicting suggestions, and the reviewers' time is wasted because several may make the same suggestions; also, usually none of the original reviewers see the revised report. The advantage of consecutive review is that each reviewer, except the first, sees a draft that has been revised with the benefit of earlier reviews; disadvantages are that the method is time-consuming and the author may waste time making unneeded revisions of revision to satisfy successive reviewers' comments.

Review also may be done individually, by small groups, or by small groups including the author. Review is rarely done by a group that does not include the author unless the author is completely unavailable. The advantage of review by individuals is that it is the quickest; the small group has the advantage of bringing together several reviewers' opinions simultaneously; and by including the author the group has the advantage of working out problems with the author as they arise and in effect revising the report as it is reviewed. In addition, review by groups is an excellent mechanism for training reviewers.

Regardless of whether review is concurrent or consecutive, and whether it is done individually or by small groups, critiques should be prepared by the reviewers.

TECHNIQUES OF REVIEW

Many techniques are involved in the process of review. Guidelines are offered here for two important aspects--mechanics and criteria--which are used concurrently.

Mechanics of Review

Review should follow logical procedures as an aid to the reviewer and to assure the author of the most perceptive possible criticism. The procedure suggested here is for the review of a long report and is stylized into steps for convenience of presentation. The procedure can be condensed for short reports and will vary with different reviewers.

1. Acquaint yourself with the background of the report as detailed in the accompanying letters, memos and critiques of previous reviewers, which should accompany the report.

2. Skim through the whole report to get an overall impression by means of the introduction, conclusions, and abstract in that order; the section headings, tables, and illustrations and their titles; and the topic and terminal sentences of paragraphs and sections.

3. Study and compare the abstract, introduction, and conclusions; are they consistent?

4. Read the body of the report carefully. Check for:
   a. Technical soundness, including the significance of the precision of quantitative data.
   b. Consistency between text, illustrations, and tables.
   c. Presentation--organization, coherence, pertinence, clarity.
   d. Expression--effectiveness and acceptability.

5. Give the report a second quick scanning to put the report and your comments into perspective and to refocus your attention on the principal problems. Reread the critiques of previous reviewers and prepare your own.

The review of a long report usually results in three types of comments: (1) brief marginal notes and interlinear changes on the manuscript; (2) more extensive comments on separate sheets; and (3) a critique which summarizes general comments and discusses the principal suggested changes. These may be consolidated for short reports, but--except for abstracts--a critique is a must.

Marginal comments should be kept to a minimum; it is far better to indicate the questioned material with a reference number or letter in the margin and to make the comment on a separate sheet. Few things are more discouraging to an author than to see page after page nearly obliterated by comments. The reviewer also should avoid writing with too hard, or too soft, pencils, and using too small a handwriting--combined they lead only to eyestrain, fatigue, and irritation.

Some reviewers and authors believe that the reviewer probably can best aid the author by raising questions rather than making changes. For example, a statement such as, "This sentence seems to imply such and such. Is this consistent with your previous statement on page so-and-so?", is preferred to a direct revision. Other reviewers and authors prefer the changes. The advantage of the question method is that it does not presume to speak for the author and permits the author to work out his own solution to the problem. The disadvantage is that it slows down revision; the author must think through the reviewer's question--which might be unclear or misinterpreted--and devise his revision accordingly. The advantage of the "revision" method is that it is quicker; the reviewer usually has a ready solution for most questions he raises and has the revision at his pencil point even as he makes his comment. The disadvantage, of course, is that he may not present the author's point of view or may change the author's meaning. Both systems are widely used, and usually the system depends on the subject matter and on the reviewer.

In general, however, technical reviewers should take care that they review rather than revise. If detailed comments and editorial changes become excessive, the report should be returned to the author for additional revision necessary to complete the preparation phase of the report. Whenever possible the reviewer should correspond, or better yet, confer with the author, particularly when extensive changes are suggested.

Criteria for Technical Review

Criteria for technical review encompass all aspects of a report--technical soundness, editorial quality, and appropriateness to the intended audience. The principal responsibility of a reviewer, however, lies in making certain the technical quality of a report is high. The criteria are presented in the form of questions because review is basically a questioning process and because it would take far more room to spell out even the main answers.

These questions, and the more specific ones to which they lead in the review of individual reports, provide an idea of the scope of technical review. These questions should be used by authors and their supervisors, as well as by reviewers, in the evaluation of reports, and as will be discussed subsequently--in the evaluation of the reviews themselves. The questions are not in an order of rank, nor are they in the order in which they might present themselves in the review of any particular report.

1. Is the statement of purpose clear and explicit? Can the purpose be fulfilled through the concepts and with the methods available? If not, does the report offer new concepts and methods or does it clearly establish the limitations of the available means? For example, perennial yield of a basin could only be estimated, and then only with the use of empirical and arbitrary assumptions.

2. Is the information worth a report of the type planned? For example, most well-site reports do not warrant the effort needed to make them Water-Supply Papers. On the other hand, is the report adequate for the stated purpose? Will the proposed publication medium reach the intended reader group? A comprehensive river-basin study should not be buried in a short open-file report.

3. Are previous studies adequately referred to and are the methods used and concepts presented up to the current "state of the art"?

4. Are the data adequate to cope with the stated purpose, and has the author done as much with the data as could be done within the scope of the stated purpose?

5. Are proper methods used to reduce the data--that is, to condense, simplify, or abstract pertinent parameters from the raw records? Are the concepts and qualifying assumptions, and the statistical and graphical methods appropriate to the reductions presented? For example, averaged well yields without reference to source rock or geographic distribution cannot be presented as a meaningful index of the potential yield of an area.

6. Are phenomena classified and defined correctly and completely? For example, well yields cannot be equated with formation yields without specific qualification regarding the conditions under which the well yield data were collected.

7. Are data properly weighted as to their reliability and are the limits of reliability presented unequivocally. Are numerical data rounded off to their proper significant figure, particularly in their use in interpretations and conclusions? Are arithmetic and mathematical presentations correct, complete, and limited to their proper scope?

8. Are analogies, extrapolations, and interpolations made within the scope of the data presented? Are abstract concepts made pertinent by being illustrated by concrete examples from the data?

9. Has the method of multiple working hypotheses been used, or has the author restricted himself only to those facts that support single hypothesis?

10. Do the data support the conclusions? Do the data support the inferences and interpretations drawn from them, particularly to the degree implied? Are data, assumptions, opinion, and interpretations properly identified and qualified as to accuracy and completeness? Is each conclusion weighted on the basis of the reliability of the individual components which make up the conclusion? For example, the reliability of a water budget should be clearly related to the reliability of the weakest assumption that went into its computation.

11. Are all the data necessary to support or corroborate the conclusions presented adequately?

12. Are the recommendations made for further studies justified on the basis of deficiencies in knowledge that showed up during the investigation?

13. Has the author looked beyond the bounds of his particular problem to indicate its relationship to the subject as a whole?

14. Is the report unified? Does all material relate to the purpose? Do text, illustrations, and tables supplement each other? Are all the illustrations and tables necessary? What is irrelevant? superfluous? parenthetic? digressive? just plain padding? Do spot checks indicate consistency of text, tables, and illustrations?

15. Is the report coherent? Is its development, from purpose through data and interpretations to conclusions, rational and thorough? Does the report progress logically from point to point and topic to topic with enough transitional material to show the relationship of its several parts?

16. Does the report emphasize its contents realistically and appropriately in keeping with its stated purpose? Do the principal facts and findings stand out clearly, or are they buried by a wealth of detail describing minor features?

17. Does the report communicate effectively with--gets its message across to--the intended reader? Is it expressed clearly enough so that its validity can be judged fairly? Do the titles of illustrations and tables indicate their purpose and significance, or just list their component parts; do the illustrations and tables show what the author says they do? Is the form of expression, regardless of originality and style, within the bounds of ordinary English grammar, accepted definitions, and the understanding of the intended reader?

18. Does the report present what the title states, and do the section headings outline a representative organization of the material?

19. Does the abstract include the significant findings and present the main contributions of the report? Is it specific in what it offers?

20. Does the report comply with Survey policy?

EVALUATION OF REVIEW

Because review is used to assure quality in reports, the quality of the review itself may influence the quality of the report. Consequently, reviews themselves need to be evaluated so as to assure those with the responsibility to forward and approve reports that the reports have received competent professional criticism.

Reviews fall short of being as good as they should be for three general reasons. First, the reviewers concentrate on only a part of their responsibilities; for example, they may revise and pick editorial or arithmetic nits but fail to evaluate the technical concepts or the completeness of the presentation. Second, reviewers may be cursory and complaisant, and fail to give a report the close study a technical review demands. Some reviewers are so familiar with the project or the report that they fail to miss what the report has omitted or unconsciously supply steps that the report has skipped. Third, reviewers may fail to be objective in their evaluation and condemn the report because it is not in accord with their views or revise it because its style is personally unacceptable.

An author's evaluation of a review, of course, is immediate and direct, but he should summarize his acceptance or rejection of a reviewer's principal comments to facilitate further evaluation of his revised report. District Chiefs and Area Hydrologist, however, have the responsibility of determining whether individual reviewers have fulfilled their responsibility. It should be just as reasonable to reject an unacceptable review as it is to return an unacceptable report.

ACKNOWLEDGMENTS

This summary is largely the result of many discussions with the three other Area Staff Assistants, W. L. Burnham, P. E. Dennis, and C. J. Robinove--particularly C. J. Robinove. It is also an outgrowth of my experience working in the Ground-Water Reports Section with C. L. McGuinness, G. H. Davis, and W. D. E. Cardwell, and of many informal exchanges with my colleagues in the Division.

REQUEST FOR COMMENTS AND SUGGESTIONS

This report is preliminary and is not to be considered as a statement of review policy. We--the four Area Staff Assistants--need and would appreciate your comments and suggestions so that eventually we can put out a practical guide to review techniques. Please send them directly to me, Atlantic Coast Area office, Arlington, Virginia, or through the Water Resources Bulletin.

Philosophy of review

(Henry Barksdale 1960)

The following comments, which are modeled after suggestions expressed in 1960 by Henry Barksdale, discuss the philosophy of review: Be objective! Be direct! Be careful! Be reasonable! Be considerate!

1. Be objective.--Examine your attitude carefully before you begin a review. Examine it at frequent intervals as the review is being made. Are you sincerely trying to improve the report, as part of a team effort, or are you trying to show how smart you are?

Comments made before reading all of a statement are apt to be the result of overeagerness to inflict criticism. When this type of comment is not corrected after the reviewer has (presumably) read the balance of the statement, it becomes obvious that the reviewer is more occupied (enamored) with what he has just said than he is with what the author is saying.

There is no proper place for sarcasm on the part of any reviewer.

2. Be direct.--Avoid vagueness. Ask your questions clearly. Make your comments clear and complete. If you can't do these things perhaps you don't understand the situation; so, be doubly careful before you criticize. If there isn't room on the page to ask an intelligent question or make an intelligent comment use a separate sheet of paper.

Isolated question marks do not constitute intelligent questions.

3. Be careful.--Are you helping to solve the problem or are you becoming a part of the problem? The author and District Supervisor certainly have a responsibility to submit a report as free from errors as they can possibly make it, and it should be realized that they have eliminated most of the errors before the report is submitted for review. From that point on, the review should be comparatively easy (in most cases). If reviewers compound the troubles by making more errors, or by introducing erroneous or unimportant concepts, nothing is gained by review.

If a reviewer is uncertain about something in a report he should do a little research of his own. If he fails to define any error in the report he should not mark up the report. By implication the reviewer is a person of knowledge and authority. So, it behooves him to be sure of himself before he marks up a report. Too much time is spent by authors in educating reviewers after reports have been bounced.

4. Be reasonable.--Constructive suggestions should be appreciated--and most of them are--but it should be obvious to the reviewers that by the time the report gets to Branch review, the work has been done and the allotted time and money have been spent.

5. Be considerate.--Put yourself in the author's shoes.

EXHIBIT 3

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington 25, D. C.

WRD POLICY STATEMENT NO. 1

June 4, 1959.

Memorandum

To: All Professional Personnel

From: Chief Hydraulic Engineer

Subject: PUBLICATIONS--Policy of the Water Resources Division

The effectiveness of the Water Resources Division depends largely on its ability to produce reports that meet the great variety of needs for water information. The solution to present and future water problems may well hinge upon the availability, quality, and timeliness of reports. Therefore, we must emphasize the production of reports that will appraise the Nation's water resources, describe techniques and methods to meet water problems, and inform the public generally about water.

Our reports should have the content, quality, and timeliness necessary to establish and maintain leadership in the field of water. Those who are responsible for project planning and execution should plan to use fully all publication media, including the Survey series, publications of cooperating agencies, journals of scientific organizations, and communications outlets to the lay public, such as newspapers, magazines, radio, and television. We must learn 1) to select from our water facts those that are newsworthy, and 2) to present those facts in a manner that will stimulate public interest and satisfy public curiosity.

Much of the success of the Division results from the composite effort of individual authors; therefore, we must continue to recognize the importance of authorship in the Division, and make every effort to aid individuals in their training and growth in proficiency as authors.

Scope of Reports

Goals for reporting during the next decade should reflect the program goals outlined in the Division memorandum, "PROGRAMS AND PLANS: Policy Guides," dated March 27, 1959. The report aspects of those goals are summarized below:

1. Publication of basic data generally will be in one of the following types of presentation:

   (a) Supporting evidence in a technical report. A technical report will not be used as a vehicle for publishing data in bulk form.

   (b) In reports designed specifically for the release of basic data, as exemplified by "Surface Water Supply of the United States." For extensive data tabulation, this form is to be used, whether the data are discharge records, well logs, chemical analyses, or others.

2. Comprehensive appraisal reports by basins, aquifers, or regions.

3. Reports on principles and techniques. Publication of these reports would partly fulfill our responsibility for leadership in hydrology. These reports ordinarily would be published in the Survey series, but some might be published in professional journals.

4. Long-range plans for water-resources investigations in a State may be published by the Survey if their contents have general interest.

5. Interim or progress reports may appear either in the Survey's series or in series of the cooperating agencies. These reports would be written for many different readership levels and developed to fulfill better the needs for timely reports for our cooperating agencies.

6. Technical handbooks and manuals describing current investigation methods used in the Division. Would include those for educational and training purposes.

7. Lay-reader reports summarizing, by States, basins, or regions, the Nation's water situation.

8. Nationwide summary reports presenting generalized hydrologic data in map or graphic form to meet general public needs. The National Atlas Series has advantages for this type of material.

9. Hydrologic almanacs, or gazetteers, for each State.

10. Books on hydrology and related fields.

11. News releases, "popular" articles, speeches, and special topics of public interest, using all effective means of communications with lay audiences.

Attainment Guides

Achievement of goals will depend on the willingness of each individual in the Division to accept fully his responsibility. Each individual must also discipline his energies and actions, using the following guides in planning and executing work:

1. Reports are the principle tangible product of the Division; therefore, in the promotion of individuals whose duties include or are related to report preparation, great weight will be given to achievement in report production. In the case of an individual not directly participating in report preparation, report production in his unit and his effectiveness in report review will be considered in promotion. The Division will examine the record of such production in considering any promotion or transfer.

2. Leadership in the field of water is in great part related to our ability to achieve a well-balanced publication program. Therefore, the number of administrative and open-file reports not designed for publication should be kept to a minimum. An administrative report usually will be abstracted from material being prepared for publication.

3. The production of timely, well-written reports results from adequate project planning and scheduling of work to allow time for evaluation of basic data and report writing. It is imperative that an author develop a report outline early in his project, preferably before results and conclusions are available--before work begins, if possible. It is imperative also that maximum use of planning aids (project description, yearly work plan) be made in developing a well-thoughtout publication schedule. This schedule should include as many as possible of the various forms of reports, such as lay-reader reports, progress reports, journal articles, and final reports.

4. The responsibility as project chief and as author must be assigned at the beginning of a project and administrative controls should be exercised to assure that the assigned responsibility is fulfilled according to plan.

5. The principal author or authors of a report must remain on their assignment at least until they have completed a manuscript which has had adequate technical review and acceptably meets editorial standards.

6. Work related to manuscript preparation, review, and revision has first priority over most other duties. All personnel who are competent to review manuscripts are expected to do some manuscript review on request. Once review responsibility is assigned, a reviewer must apply himself immediately and diligently to the review task and must meet the deadlines mutually agreed upon.

7. The immediate supervisor of an author is responsible to assure that the author's report adequately meets standards before transmitting it to higher levels for review. The Division policy is to provide an author with the assistance and constructive criticism of specialists who are qualified in the subject matter of his report.

8. The effectiveness of a supervisor in generating and handling reports will be judged on the quality of the reports that come out of his office, and this factor will be considered in appraisals of the supervisor's qualifications for greater responsibilities.

9. Within the general policy of the Geological Survey, it is the intent of the Water Resources Division to provide an author with the opportunity to publish his individual ideas, whether or not they are accepted by his colleagues. The author must, however, show that he is acquainted with previous work by others, present a clear and logical argument in defense of his own ideas, and show that he has responded constructively to the comments, suggestions, and criticisms of reviewers.

Responsibility of Author, Supervisor, and Review Personnel

We aim to release from the office of origin only those reports that meet reasonable technical and editorial standards. We intend to accomplish this by providing an author and his supervisor with a workable and constructive procedure for quality control. The basic element in this scheme is to place on the supervisor from whose office a report originates the principal responsibility for these standards. A definition of responsibility at all levels is described in the following paragraphs:

1. It is an author's responsibility to keep his supervisor informed and to seek his help in planning for a report as the project proceeds.

   An author bears the primary responsibility for the content of his report, but he is expected to seek and judiciously use the advice of his supervisor, of his colleagues, and of technical advisors recommended by any administrative level.

   An author is expected to keep himself informed on correct editorial practices and to prepare his report conscientiously in accordance with high editorial standards. Review at higher levels shall not be depended upon to compensate for poor work on the part of an author.

   When a manuscript is considered to be ready for review, the supervisor will arrange for review by one or more qualified professionals within the Survey (in some cases from outside the Survey). The author may assist his supervisor by suggesting appropriate reviewers. Comments by the reviewers must be considered in the preparation of a final draft to be presented to the author's supervisor for subsequent transmittal through channels toward ultimate publication. The manuscript should be accompanied on its movement to all administrative levels by a brief summary of the comments of each reviewer and of the changes that were made in response to the reviewer's suggestions. This summary should be matter-of-fact and dispassionate. If necessary, the supervisor will prepare the summary. If any significant suggestions made by the reviewers are not accepted, the author will present reasons why he found the suggestions unacceptable.

   Regardless of where an author may be during the final stages of the review and publication of his paper, he has the responsibility to do whatever work on his manuscript that may be necessary at any time. Supervisors should assure that commitments on new projects will allow for work on unpublished manuscripts from previous projects.

2. The principal administrative responsibility for the technical and editorial adequacy of an author's report rests with his immediate supervisor. It is not the intent of this policy, however, to make an editor out of a supervisor. Nevertheless, a supervisor will be held accountable if he forwards to higher level a report that clearly is inadequate in any important respect. This responsibility requires that a supervisor will give each report passing through his hands sufficient review to assure himself of the worth of its content, the adequacy of the technical review it has recieved, and the editorial quality of the manuscript. It cannot be too strongly emphasized that if a supervisor has properly consulted and advised with an investigator throughout the progress of a project and in the planning of the report, little additional burden is imposed by the responsibilities outlined above.

The immediate supervisor of an author shall transmit a manuscript to the next highest administrative level along with his comments and recommendations on type of publication.

3. Branch Area Chiefs will receive report manuscripts from originating offices, or project chiefs where appropriate. They will give sufficient review to reports to satisfy themselves that they are adequate in quality. Suitable reports will be forwarded with Area Chiefs' recommendations to the Branch headquarters through channels specified by the Branch Chief. Report appraisals will be a principal source of information on the performance of District Chiefs and Project Supervisors. A Branch Area Chief, having received a report deemed inadequate either by himself or by the Reports Section of his Branch, will inform himself fully on the nature of the inadequacies and give whatever help he can to the supervisor and to the author in preventing future recurrences of deficiencies, as well as in improving the report in question.

4. The principal purpose of review by the Branch Reports Sections is to judge the scientific and technical quality and the overall adequacy of the reports received, to make editorial and technical improvements of modest character, and to keep adequate records and control of report production and progress. The Branch headquarters will provide Branch Area Chiefs and the Division Chief with quarterly summaries showing the status of reports.

   Reports found by a Reports Section to require more than minor adjustments shall be returned promptly to the originating office through appropriate channels.

   A Reports Section should make only such technical review of a manuscript as is necessary to judge the overall quality, except in cases where, because of the nature of the subject, a member of the Reports Section staff is a logical technical reviewer. A Reports Section is expected to depend largely on the technical reviews made before the report is submitted. A Reports Section, however, must satisfy itself that the technical review has been competent and thorough. In the case of a report which has had inadequate technical review, the Branch should see to it that further review is arranged for. A Branch has the responsibility for setting up standards for appraising the adequacy of technical review, including prior approval of proposed reviewers, if appropriate.

   Reports having met all requirements, including those of a Reports Section, [they] shall be forwarded to the Division Publications Officer, through channels prescribed by the Branch.

5. The Division Publications Officer is responsible to assure himself of continuing adequate quality of reports submitted for release or publication. Although the Publications Officer does not have

routine technical review functions, he will review reports to the extent necessary to discharge his responsibilities. He will devise and maintain records and control documents needed for constant surveillance of the quality, progress and production schedule of reports.

Reports for which release or publication is desired will be channeled through the Division Publications Officer, who is the central and principal contact with units outside the Division in all matters pertaining to reports. He transmits reports to the Director's Office, for example, and they are routed back through him from that office. Printer's proofs of reports also pass through the Division Publications Officer.

The Division Publications Officer will make summary quarterly reports to the Office of the Division Chief on the status of reports, and will furnish copies of this report to Branch Chiefs.

Luna B. Leopold

United States Department of the Interior
GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

4251 0014
ACH/SP&DM

March 4, 1977

WATER RESOURCES DIVISION MEMORANDUM NO. 77.61

Subject: PUBLICATIONS--Processing of Reports

You are all aware of the Division's continuing objective--that our reports must be timely and excellent in technical content. The purpose of this memorandum is to emphasize my deep concern for both objectives and to reiterate Division report-preparation practices established to ensure high-quality reports.

I would like to reemphasize a long-standing principle with regard to the technical and editorial quality of our reports; no distinction should be made between the different series of reports. The reputation that the Survey has enjoyed for almost 100 years derives in large part from the quality of its reports. We must make every effort, despite the increasingly heavy workload, to maintain this quality.

To address the problem of report preparation and review as they affect timeliness and quality, District Chiefs, with the assistance of other personnel should take the following steps to improve report management at the District level:

1. Utilize a reports-management program:

   A. Maintain a system for project review, control, and report processing using sound management techniques. Frequent monitoring is required, especially in the post-review stage.

   B. Train writers and reviewers, in-house and through the Denver Training Center.

   C. Train support personnel for special typing, drafting, and editing requirements.

   D. Ensure that all personnel carrying reports responsibilities understand and fulfill them.

   E. Ensure that personnel involved with reports, including support personnel, have ready access to standard references, such as "Suggestions to Authors," "GPO Style Manual," and "WRD Publications Guide."

2. Implement and emphasize quality control over mechanical errors. Mechanical errors can be virtually eliminated.

3. Use pre-project reports. Define the existing data base before planning field work and prepare a report containing information available and work plans for achieving the objectives of the project.

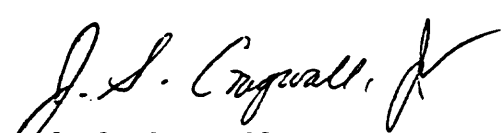
4. Ensure that reports are reviewed by qualified personnel. Select no more reviewers than are needed to guarantee complete review of all topics covered in the report.

5. Be sure that technical and editorial reviews are both thorough and prompt. Ascertain that author's responses are adequate and prompt.

6. Above all, involve key District personnel in the report preparation and review process. District personnel must understand that the Division supports and encourages report-preparation activities. Also, emphasize the necessity and desirability of serving as a technical reviewer.

7. The manuscript-routing sheet should reflect only technical and management review and processing after the report has reached the finished manuscript stage. Manuscript routing sheets should not be cluttered with records of editorial mechanics and other routine handling in the originating office. Intra-office records showing reports processing prior to technical and management review should be reflected on a separate routing sheet in the originating office.

This memorandum highlights some steps to improve report preparation and review at the District level. We will also strive to sharpen report handling procedures at Regional and National Headquarters. Reports are one of the principal tangible products of the Water Resources Division. It is imperative, therefore, that we all strive for the goals of quality and timeliness.



J. S. Cragwall, Jr.
Chief Hydrologist

WRD Distribution: A, B, S, FO, PO

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

December 22, 1978

WATER RESOURCES DIVISION MEMORANDUM NO. 79.43

Subject: PUBLICATIONS--Policy of the Water Resources Division Regarding Written Reports

This memorandum updates WRD Policy Statement No. 1 (June 4, 1959) and amendment (March 7, 1963). My purpose is to reemphasize the importance of the written report, to review and emphasize the placement of responsibility and credit for reports, and to reiterate that authorship enhances professional development and career opportunity.

I have refrained here from discussing the planning and writing of reports, the publications media available for Survey authors, and the organizational and hierarchical responsibilities and procedures for review and publication. These are important, but they are addressed in the several editions of Suggestions to Authors culminating in the Sixth Edition, recently published--and in the Publications Guide and technical memorandums of the Water Resources Division, with which you should be familiar.

The Written Report

The Act of Congress which created the U.S. Geological Survey in 1879 established the obligation to make public the results of its investigations. The written report (cartographic or textual) fulfills this obligation for the Survey's program of investigation and research. It serves to archive our findings and to disseminate them.

Three developments during the past dozen or so years--the advent of the computer age, the enlargement and diversification of the user audience, and the effects of inflation on the cost of the traditional Survey book publications--have influenced attitudes toward the written report. These developments have led to a reevaluation of the most suitable form for presenting the results of our work, and have engendered a feeling by some that the written report is being deemphasized as the principal product of the Division. Indeed, the computer printout and computer program are new forms of products, and others are likely to come. However, the written report will continue as a primary vehicle for disseminating and archiving results of research and investigations. Well-written, timely reports are more important than ever because of the enlarged user audience and increased relevance of our work to real world problems.

Responsibility and Credit for Reports

It is Geological Survey policy that its investigators bear primary responsibility for their findings and be credited publicly for their work. This policy stems from recognition that the success of the Survey in carrying out its mission is entirely reliant upon the skill and dedication of its employees. Implementation of this policy requires that Survey investigators document their work and findings, and that authorship of reports be displayed clearly.

The Geological Survey has a proprietary interest in, and is accountable for, the work performed by its employees. Accordingly, supervisors at all levels share the responsibility for assuring that reports prepared under their supervision are accurate, well-written, impartial, and in conformance with Survey policies.

Procedures exist to provide support to authors in the preparation, review, and publication of reports, and to facilitate the carrying out of supervisors' responsibility. Of particular note, because it is part of the nucleus of our system of assuring technical excellence, is the practice in the Water Resources Division of technical reviews by colleagues. As an integral part of their Survey responsibilities, all employees are expected to participate in technical review when asked. Participation in such reviews has priority over other duties, within realistic management constraints. The colleague should take responsibility for technical reviews as seriously as he does his responsibility for his own reports. The District Chief or Program Manager has primary responsibility for assuring the adequacy of colleague review--at both ends, the author's office and colleague reviewer's office.

Authorship

I emphasize here the benefits of authorship to the individual. Authorship credits professional achievement for it associates, on the record for all to see, the individual and his contribution. There are, of course, other expressions of professional achievement, but none so clear and lasting in our kinds of work as that expressed by authorship. Careers are not made by bibliographies, but professional reputations are enhanced by good work as expressed in high-quality reports. The aid to career advancement should be self-evident.

Summary

The written report will continue to serve the Survey as a most important medium of information transfer to the public. The timeliness and high quality of the written report brings credit to the Survey and enhances

the professional reputation and chances for career advancement of the author. All levels of project and program supervision share the responsibility for assuring the timeliness and quality of our written reports.

J. S. Cragwall, Jr.
Chief Hydrologist

Distribution: A, B, S, FO, PO

EXHIBIT 4

U.S. GEOLOGICAL SURVEY
New York District

November 1980

MANUSCRIPT CHECKLIST FOR AUTHORS

Title_____

Authors_____

Publication Series_____ Project no._____

This form must be completed by the author and signed by his supervisor before the report is submitted to the Publications Unit for processing. The author writes in each box either his initials to indicate OK or a dash if the item is not applicable. The author is expected to be familiar with the pertinent sections of STA and WRD Publications Guide.

MANUSCRIPT

Purpose of study is stated in introduction; report fulfills stated objective	
Publisher's specifications have been obtained and followed; copy of specification sheet for non-Survey reports is included with manuscript.	
Preliminary pages and support documents are in correct format. (Refer to Pub. Guide and published samples; cross out those that do not apply) ☐ cover ☐ conversion table ☐ title page ☐ text abstract ☐ table of contents ☐ press release ☐ list of illustrations & tables ☐ WRSIC sheet	
Title of report is as short and explicit as possible	
Wording of title is same on cover, title page, abstract, and support documents	
Cooperating agencies are named on cover, title page, and in introduction	
List of illustrations identifies each figure as map, graph, photo, etc.	
Conversion table contains all units of measure used in text, illustrations, and tables; conversion factors have been verified	
Use of metric or U.S. Customary units is consistent in text, tables, and figures	
Acknowledgments are in accordance with STA guidelines (6th ed., p. 44)	
Abstract is written in accordance with Pub. Guide, sec. 1.07.2	
Abstract and conclusions contain only information that is given in text; abstract tells what report contributes	
Pagination is consecutive with cover page as 1 (not i)	
Headings and subheads are in publisher's style (see published reports); their rank is indicated by indention in table of contents	
Each illustration is referred to in text; its location in text is indicated by a "cut-in" following principal reference	
Caption sheet follows the principal reference to each figure, multiple captions are listed on same sheet	

Wording on caption sheets agrees with that in list of illustrations except that phrase "map showing" is deleted	
Entire manuscript is double spaced to allow editorial work	
Routing sheet is complete and up to date	
WRSIC sheet is double spaced and contains 200 words or less	
Press release (if needed) is lively and written in accordance with Pub. Guide, sec. 17	
Letter of permission to publish has been requested from cooperator (needed from Federal cooperators only	

ILLUSTRATIONS

Final illustrations will be done by: ☐ District draftsman ☐ Publisher Number of figures _____ Number of plates _____	
Special presswork (color, oversize, foldout) is within publisher's capability	
Each illustration is essential and is referred to in text	
Illustrations are designed in accordance with Pub. Guide, sec. 3	
Similar illustrations are consistent in format and wording	
Explanations within figures and plates are complete and in accordance with Pub Guide	
All illustrations (except plates) are page size and reproducible	
Final lettering will not need to be smaller than 8 point (This is 8 point.)	
All maps show lat., long., and scale	
General location map is included in first appropriate figure	
Base maps have been discussed with draftsman to determine manner of data presentation. Same base is used wherever possible	
Figures are together at end of report, not within text	
Each figure is clearly numbered; caption is attached on a separate page	

TABLES

All tables are essential and are referred to in text	
Table headings are as short and descriptive as possible	
Similar tables are consistent in format and wording	
Data in tables have been cross checked against figures and text	
Tables conform to Survey style (STA and recent Survey pubs. contain examples)	
Regular tables follow principal reference in text; lengthy tables and computer printouts are at end of report	
Principal reference to each table is followed by a cut-in notation	

Author's supervisor _____ Date _____

UNITED STATES GOVERNMENT

EXHIBIT 5

Memorandum

TO : Eugene P. Patten, Ground Water Branch, Reston, VA

DATE: Feb. 3, 1982

FROM : Peter Haeni, WRD, Hartford, CT

SUBJECT: PUBLICATIONS.—Review of "Regional correlation of surface and borehole geophysics with hydraulic conductivity in fractured dolomites in the Pecos River Valley, New Mexico"

I have given this report a quick technical review and have some serious reservations about it. As you know, many researchers have worked on the relationship between hydraulic conductivity and surface resistivity measurements. Since there is no direct relationship between porosity and permeability, all of these workers have come up with various empirical relationships that can be useful in very specific hydrologic and geologic settings.

A very heated discussion of this topic has taken place in Ground Water over the last several years. The latest in this series can be found in the Discussion of Papers - "Ground Water", Jan-Feb 1982, p. 111. It seems prudent, therefore, to carefully document and review any investigation and subsequent publication of Survey findings in this area. Specifically, great care must be taken to ensure that readers of the report clearly understand the underlying empirical approach and the details of the hydrologic and geologic setting where this relationship was worked out.

The subject report does not accomplish this and without major revisions and rigorous technical Survey reviews, I do not feel it should be published by the Survey. One possibility is to let the Bureau of Reclamation publish the report since the work and reviews were carried out by their employees.

The following specific comments are made about the manuscript:

1. Routing Sheet - This report received no USGS technical review. The reviews from Bureau of Reclamation personnel appear to be cursory at best. If the report is rewritten, it should be submitted to at least one USGS technical reviewer.

2. Title - This is very misleading. The report does not correlate surface and borehole geophysics with hydraulic conductivity on a regional scale. It develops an empirical relationship between surface resistivity, and pump in test derived hydraulic conductivity values, and neutron log counts at a specific site.

3. Press release, WRSIC abstract, Introduction - The goals and objectives of the study do not agree in these sections.

4. Geology - This section is much too brief. In the title of the report, fractured dolomites is mentioned. In this section, not one word is said about fractures, their extent and hydrologic significance. A typical geologic cross section is needed. The next section talks about confining beds. This section should tell how thick these beds are, how numerous, are they also fractured, etc.

5. Calculation of Hydraulic Conductivity - The reference for this technique, Cornwell, or Zanger (1953), is not on the reference list. The theory is stated as being verified by electric analog experimentation. Since the rest of the report compares the geophysically derived data to this field data, the methodology needs to be reviewed by the Survey. Does the Survey accept this method as a valid method of defining hydraulic conductivity? From the title and brief geologic description, there seems to be some question as to how valid the confined aquifer assumption is in this case. What are the effects of hydro facturing, clogging by the injection water, fracture patterns, etc.?

6. Theory - Again, this section should clearly state that empirical relationships are being developed. The relationship of porosity vs neutron counts was developed using laboratory core porosity values. If this is really a study in fractured dolomites, how are the fractures treated? What does the laboratory porosity value of a small sample really mean in a fractural rock area?

7. Resistivity Sounding Data Analysis - The interpreted resistivity profiles should be compared with drill hole data to verify that the computer interpretation is a unique solution to the problem.

8. Mapping Regional Trends - Ground-water resistivity values were taken in wells. Where were these wells screened? Is this value an average over the entire section or from one zone or aquifer? Figure 10 indicates a significant change in the resistivity of the ground water. Values ranged from 2.1 to 15 ohm meters. This range in values could have a significant impact on resistivity values measured by surface methods. Are the water samples representative of formation water? The text states that samples were taken after several months. The example presented in this section could not be worked out nor do the results make any hydrologic sense, i.e.:

   if R_t < 52 ohm meters, then K > 500 ft/year
   if R_t < 32 ohm meters, then K > 10,000 ft/year

   Something is wrong, but I don't know what. It seems however, that very small changes in R give very large changes in K for a given Rw. This seems to make the method impractical, and should at least be mentioned in the report.

   The formulas presented for calculating hydraulic conductivity parallel to and perpendicular to the bedding planes assume that $K_v = K_h$ in each individual layer. This is probably not the case at this site, but not enough information is provided to determine whether this is a good assumption or not.

Figure 11 is very hard to understand. What hydrologic meaning does hydraulic conductivity perpendicular to the bedding planes from 0 to 300 ft have? The shaded portions of the diagram either represent hydraulic conductivity values that are negative -2, or 10^{-2} ft/year. Neither of these values is reasonable.

Figure 12 - Which hydraulic conductivity was used to calculate T? A T map with a uniform depth is really a K map multiplied by a constant!

9. None of the diagrams meet Survey requirements. The entire text needs a thorough editorial review.

10. References - References to, and a short discussion of other researchers' work in this area should be added to the report.

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Peter Haeni

EXHIBIT 6

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
EGS-Mail Stop

August 31, 1982

Memorandum

To: District Chief, WRD, St. Louis, Missouri

From: District Chief, WRD, Peoria, Illinois

Subject: PUBLICATIONS--Colleague Review of Report: "Hydrology of the Green River Basin, Beefeater County, Illinois," by A. B. Colby and D. E. Farley

The attached subject report is being sent for technical review per our telephone discussion of August 15, 1982. This is the final report for our project ILL-83 that was conducted in cooperation with the Beefeater County Planning Board. The purpose of the study was to determine the availability of ground water in the Green River basin and potential effects on the aquifer and streamflow from the growing use of ground water for irrigation in the western part of the basin. Results of this study will be relied on heavily by the County Planning Board for issuing irrigation permits to irrigators in the basin.

As I mentioned in our previous discussion, George Isador was suggested as a colleague reviewer by the Ground Water Branch because of his expertise in ground-water modeling. Although we would like a thorough technical review of the entire report, we would appreciate George's specific attention to the modeling aspects on pages 24-30, and especially the assumptions used in the model.

Thank you for your help in this colleague review. We will be happy to reciprocate if the occassion arises in the future. If possible we would like your finished review by September 25, 1982.

X. Y. Zebor

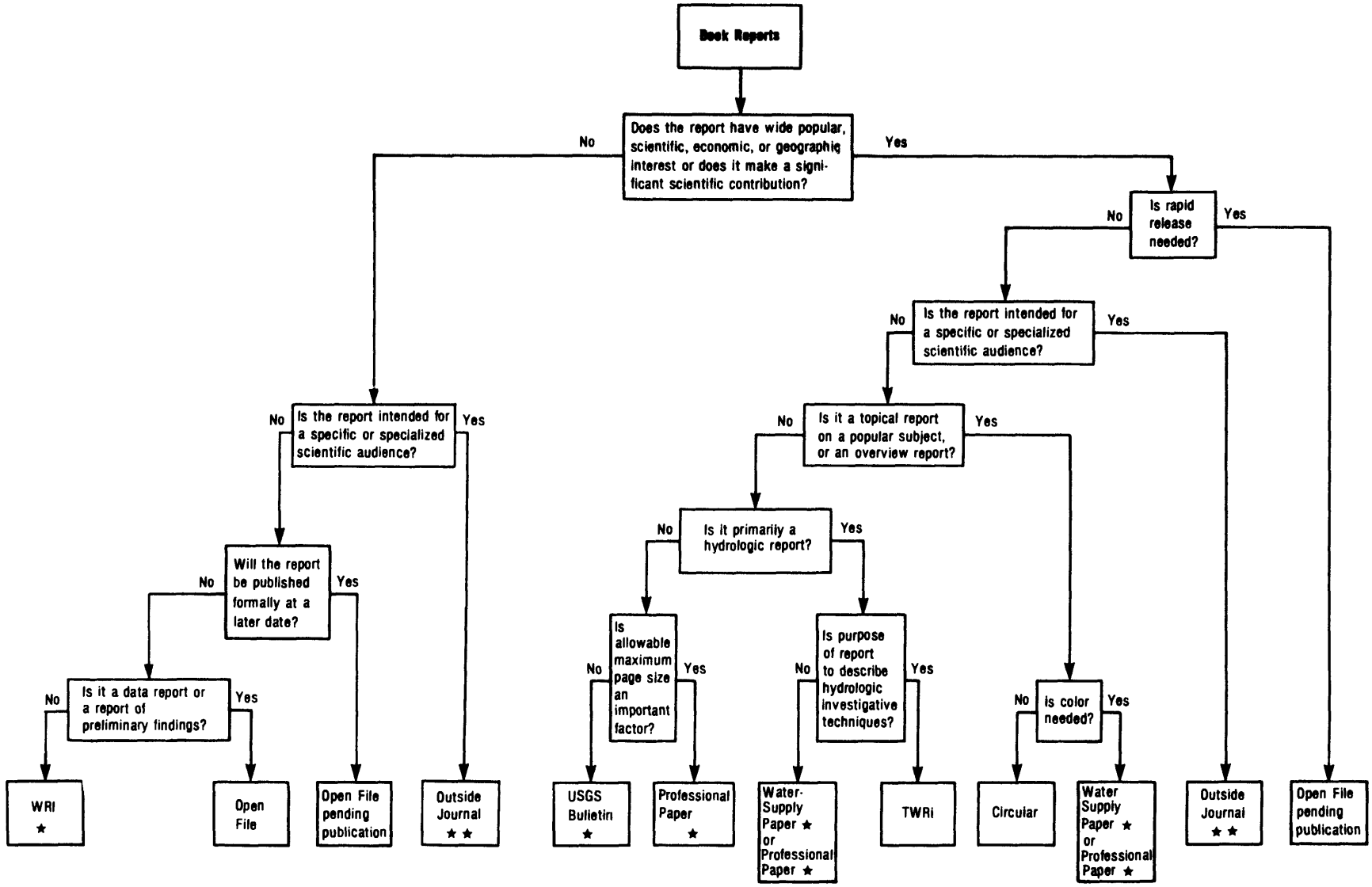
Attachment

CONTENTS

CONTENTS--Continued

DECISION TREE FOR SELECTING PROPER OUTLET FOR WRD-PREPARED BOOK REPORTS

(Any book or map report released to the public may be published by a cooperating agency. The quality and distribution of book and map reports published by cooperating agencies may equal or surpass that of equivalent USGS publications.)



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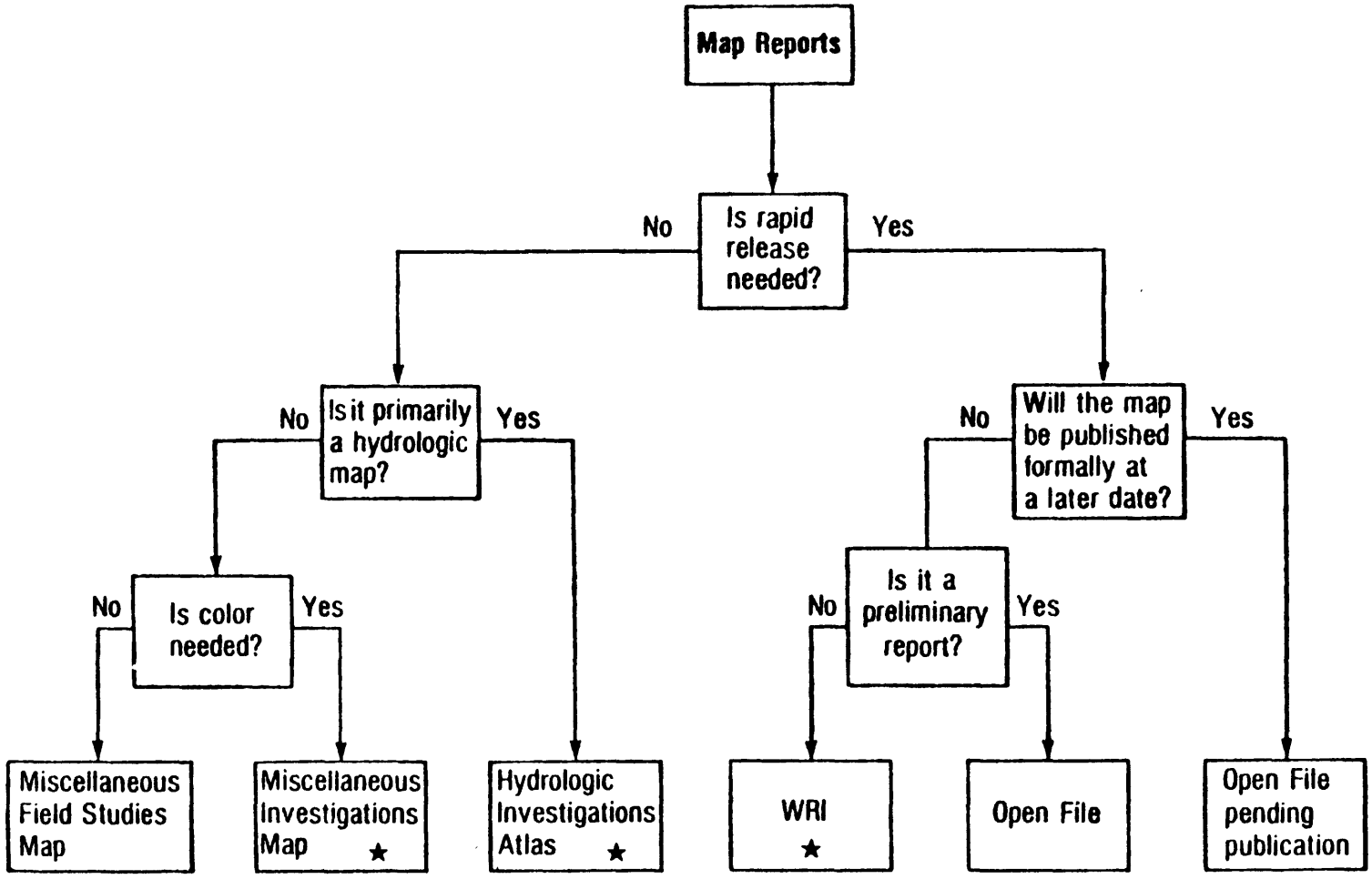
★★ Use of color, plates, or oversize illustrations optional with publisher

Prepared by: Office of Assistant Chief Hydrologist for Scientific Publications and Data Management
440 National Center, Reston, Virginia 22092

DECISION TREE FOR SELECTING PROPER OUTLET FOR WRD-PREPARED MAP REPORTS

(Any book or map report released to the public may be published by a cooperating agency. The quality and distribution of book and map reports published by cooperating agencies may equal or surpass that of equivalent USGS publications.)



★ Color is permitted (with approval of the Scientific Publications Section)

Prepared by: Office of Assistant Chief Hydrologist for Scientific Publications and Data Management
440 National Center, Reston, Virginia 22092

ABSTRACT

Limnological data collected at Lake Koocanusa were used to investigate the relationship of nutrient loadings, primary productivity, and trophic state for the reservoir during 1972-80. Loadings of nitrogen and phosphorus were found to be potentially eutrophic prior to and following impoundment of Lake Koocanusa. However, annual areal primary productivity during the study ranged from 23.2 to 38.5 grams of carbon fixed per square meter and, thereby, categorized the reservoir as oligotrophic.

The discrepancy in trophic state was mainly attributed to the failure of nutrient loading models to adequately account for limnological processes in reservoirs. The distribution of chlorophyll "a" within the water column indicated that, on the average, more than one-half of the phytoplankton was beneath the euphotic zone.

EXHIBIT 11

INTRODUCTION

The Metropolitan Sanitary District of Greater Chicago (MSDGC) produces over 500 dry tons of sewage sludge per day through treatment of wastewaters from sanitary facilities (J. Peterson, written commun., 1979). Consequently, there is critical need for a safe, economical, and environmentally acceptable disposal method. The MSDGC began research into land application of digested sludge in the mid 1960's.

Sludge contains substantial quantities of nutrients, primarily phosphorus and nitrogen, and application to deficient soils could help restore agricultural productivity. Sludge may also contain potentially harmful constituents such as heavy metals, pesticides, and polychlorinated biphenyls (PCB's). The concentrations of these constituents in sludge may be high relative to those in natural soils and waters and thus may undesirably alter the water quality.

In Illinois, more than 100,000 acres of land had been surface mined for coal before the enactment of reclamation laws in 1962 (Haynes and Klimstra, 1975, p. 18). It was suggested that the application of sludge as a soil conditioner and fertilizer might serve as an effective method of reclaiming this land. Thus, in 1970, the MSDGC began acquiring and recontouring surface-mined land about 25 miles west of Peoria, near the towns of Canton, Cuba, Bryant, and St. David in Fulton County, Illinois (fig. 1). Reclamation involved barging sludge approximately 200 miles down the Illinois River from Chicago to Liverpool, Illinois. The sludge is pumped 10 miles through pipelines to four sludge storage basins within the project area, and then pumped through a piped distribution system from the storage basins to the fields.

In 1971, the U.S. Geological Survey (USGS) began a cooperative project with the MSDGC to measure stream discharge, suspended-sediment loads, and chemical constituents in surface water in the project area. Sludge application began on the 15,528 acre area in 1972 (Zenz, Peterson, Brooman, and Lue-Hing, 1976, p. 2333). In 1976, the cooperative project was expanded to include monitoring of shallow ground-water levels and ground-water quality.

The purpose of the cooperative project was to provide background data on surface-water quality and quantity and to establish and maintain stations to monitor changes or trends caused by site preparation and sludge application. In 1967, monitoring of ground-water quality was added to the project to acquire baseline data on concentrations of chemical constituents in ground water. Ground-water levels were measured and used to prepare a water-level contour map and to define temporal and spatial differences in water-levels.

This report contains a general description of the hydrology of the project site, summaries of the data collected during 1971 to 1978, and discusses some of the factors affecting the hydrology of the site. This information and the water-level contour map (Fuentes and Patterson, 1979) will be helpful in designing an effective ground-water monitoring program and will provide baseline hydrologic information from which future changes can be detected.

PURPOSE AND SCOPE

This report describes the results of an investigation conducted by the U.S. Geological Survey to evaluate a technique proposed by Stallman (1956, 1967) to determine approximate ground-water budgets for small plots of land. The method should be useful to determine evapotranspiration from plots large enough to be representative of the field environment, but small enough to determine, for example, evapotranspiration from ground water for areas with specific types of plant cover or with water tables of different depths below land surface. The study included investigations at four sites in the flood plain of the Arkansas River in Colorado. A knowledge of evapotranspiration from ground water in the flood plain was needed to refine estimates of the effects of ground-water pumpage on streamflow and to evaluate the feasibility of augmenting streamflow by phreatophyte eradication or channel straightening.

DISSOLVED-OXYGEN MODELING APPROACH

Design of the Study

The framework of the study program was based on the philosophy (Rickert and Hines, 1975; Hines and others, 1975) that repetitive, intensive synoptic studies will explain more fully the cause-effect relationships concerning river-water quality than will monthly monitoring.

A mathematical-modeling approach was applied to the DO regimen in the Willamette and Santiam Rivers because the technique provided the most potential for quantifying the fundamental cause-effect relationships. (See Rickert and others, 1976, for model-approach philosophy and data needs.) The approach is designed to simulate the common processes of carbonaceous and nitrogenous deoxygenation, reaeration, and benthic-oxygen demands. Photosynthesis is not directly accounted for in the approach, but can be introduced where needed to fit the measured data.

The size and complexity of most rivers limit the capability for studying all seasonal variations in the DO regimen. Therefore, it is most advantageous to conduct a DO study during the time period in which the river is under the greatest DO stress. In the Willamette, this period generally occurs during summer, when flows are low and water temperatures are high, and is the critical one for planning and management. A major advantage of examining DO levels during this critical period is that near steady-state flow conditions occur, which obviate using estimated dynamic parameters in the analysis.

Three intensive weeklong river-quality surveys were done to evaluate the significance of $CBOD_{ult}$, nitrogenous biochemical-oxygen demand (NBOD), benthic-oxygen demand, photosynthesis, and reaeration on the water quality of the Willamette and Santiam Rivers. One survey was done on the lower Santiam River during July 1978 and two surveys were done on the upper Willamette River (Eugene to Salem) during August 1978. From these surveys, $CBOD_{ult}$ and NBOD loads and rates of deoxygenation were calculated and assessments were made to determine if the rivers were experiencing DO problems. In these reaches, the rivers are considered to have DO problems if the 24-hour average DO concentration drops below the State water-quality standard of 90 percent saturation.

Sampling-Site Selection

Table 1 summarizes the times, locations, and general nature of the intensive DO studies. For those areas expected to be sufficiently DO stressed to model, extensive cross-sectional channel geometry data were collected. The cross-sectional data are used in the model to define rates of reaeration and times of travel for each river segment. Table 1 also outlines the field program of algal reassessment.

Individual sites for sampling (fig. 3) were selected based on the location of waste-water outfalls and tributaries, accessibility of boat-launching areas, and availability of bridge-measuring sites. (See Hines and others, 1977, for philosophy of site selection.)

Methods and Procedures

In general, the methods and procedures used during the 1978 Willamette-Santiam assessments were those described by Hines and others (1977). One exception is that ultimate CBOD ($CBOD_{ult}$) concentrations were calculated (using Lee's grid) from 15-day CBOD rather than 20-day CBOD tests. Review of previous work on the Willamette River indicated no significant differences in $CBOD_{ult}$ demand and k_1 rates calculated from either 15- or 20-day CBOD tests.

Sampling-site time schedules for the Willamette surveys and the Santiam survey were selected to make maximum use of equipment and manpower. The work on each Willamette DO survey involved two overlapping study areas. The first study area included all tributaries, municipal and industrial waste-water sources, and main-stem Willamette sites between RM 195 and Corvallis (RM 134.3). The second study area covered all remaining sites from Corvallis (RM 134.3) to Salem (RM 84). The Corvallis site on the Willamette River was monitored continuously during each Willamette survey and was the ending site of the first study area and the beginning site of the second study area. In each Willamette DO survey, collection on the first day consisted of sampling waste sources and tributaries in the first study area. Collection on this first day provided lead-in data to the intensive river sampling done on the second and third days from RM 195 to Corvallis. Collection on the third day provided lead-in data for the second study area (Corvallis to Salem). Intensive river sampling in the second study area was done on the fourth and fifth days.

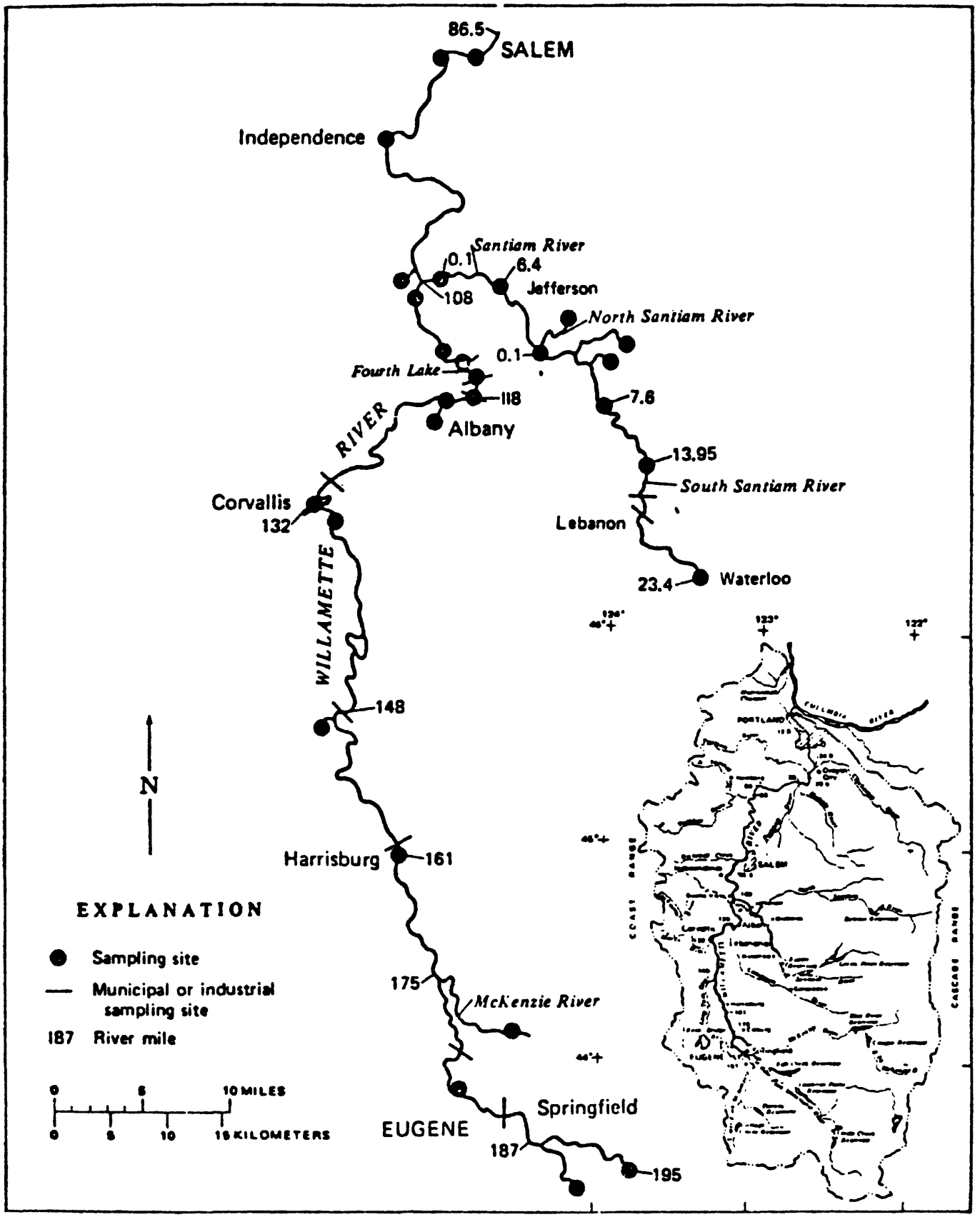


FIGURE 3. – Upper Willamette River basin, showing sampling-site locations on the Willamette and Santiam Rivers.

Table 1.--Summary of studies in the upper Willamette River basin during 1978

Description	Dates	Sampling sites
Cross-sectional geometry data.	June 5-9	Willamette River, cross-sectional depth profiles at approximately 0.2- to 0.3-mile intervals between RM's 120 and 83.8.
DO study		
South Santiam River, RM's 23.4-0.0.	July 23-28	South Santiam River, RM's 23.4, 13.95, 7.6, 0.1. Also three tributaries and two waste-water outfalls.
North Santiam River, RM's 2.9-0.0.		North Santiam River, RM 2.9
Santiam River, RM's 11.7-0.0.		Santiam River, RM's 6.4, 0.1
Collection of periphyton and phytoplankton algal samples.	August 4, 7-8, 16-17.	Willamette River, RM's 185, 176.5, 169, 161, 156, 141.7, 132, 118, 111, 107, 100, 86.5, 78, 72, 56, 50, 39, 33, 20.5, 12.8, 7.0. McKenzie River, RM 0.1 South Santiam River, RM's 23.4, 13.95, 7.6, 0.1 Santiam River, RM's 6.4, 0.1 Tualatin River, RM 0.1 Clackamas River, RM 0.1.
DO study		
Willamette River, RM's 195-85.9	August 7-11	Middle Fork Willamette River, RM 195 Coast Fork Willamette River, RM 6.4 Willamette River, RM's 180.7, 161.2, 134.3, 119.6, 118.1, 116, 115, 113.5, 108, 85.9. McKenzie River, RM 7.2 Santiam River, RM 0.1 All other major tributaries and all major waste-water outfalls.
DO study		
Willamette River, RM's 195-85.4	August 28-September 1.	Middle Fork Willamette River, RM 195 Coast Fork Willamette River, RM 6.4 Willamette River, RM's 180.7, 161.2, 134.3, 119.6, 118.1, 116, 115, 113.5, 108, 85.4. McKenzie River, RM 7.2 Santiam River, RM 0.1 All other major tributaries and all major waste-water outfalls.

In the Santiam DO survey, 4 days of lead-in data were collected at sites on tributaries and at municipal and industrial waste-water sources. These same sites were sampled on the fifth and sixth days, together with all main-stem South Santiam and Santiam River sites.

During the three surveys, more than 660 15-day CBOD tests and 285 individual nitrogen-species analyses were made on samples of river and waste waters. In addition, algal populations from 30 sites on the main stem and tributaries of the Willamette River were identified for phytoplankton; 12 of those sites were also selected for periphyton identification.

EXHIBIT 14

SUMMARY AND CONCLUSIONS

Since 1972, the Metropolitan Sanitary District of Greater Chicago has been applying digested sewage sludge as a fertilizer and soil conditioner to a 15,528 acre recontoured surface-mine area in Fulton County, Illinois. In 1971, the U.S. Geological Survey began a cooperative project with the MSDGC to measure stream discharge, suspended-sediment loads, and chemical constituents in surface water in areas affected by the reclamation. In 1976, the project was expanded to include a study of the shallow ground water.

No significant changes from 1971 to 1978 were found in runoff per square mile for Big Creek between stations upstream and downstream from the reclamation site. Discharge hydrographs of two tributary streams draining the reclamation site show that, after periods of precipitation, the discharge of the tributaries does not increase at the same rate as discharge in Big Creek. The delayed response of the tributaries is owing to the damping effect of several strip-mine lakes.

Yearly suspended-sediment yields calculated for the upstream and downstream stations on Big Creek range from under 600 to over 1,200 tons per square mile of drainage area at each station. The two stations show no apparent differences between the sediment yield from the reclamation site and the yield from upstream sources.

The analyses of water samples collected at four stream-monitoring stations show the principal cations to be sodium, calcium, and magnesium. The principal anions were chloride, sulfate, and bicarbonate. The chemical composition of the surface water varies greatly from month to month; however, comparison of

yearly mean concentrations show no changing trends at any station, nor are there any apparent differences attributable to sludge between stations upstream and downstream from the reclamation site.

The shape of the water table is irregular and generally follows the topography. Monthly water-level fluctuations depend upon two factors: (1) the type of land (mined or unmined), and (2) proximity to surface discharge. The largest fluctuations were in wells in unmined land away from discharge (monthly mean of 2 feet); the smallest fluctuations were in wells in mined land near discharge (monthly mean of 0.61 ft). The water table was closer to the surface in unmined land (mean depth to water 29.51 ft). The chemical characteristics of ground water seem to have been altered by surface mining, as indicated by high concentrations of sulfate, calcium, magnesium, chloride, iron, zinc, and manganese in water from wells in surface-mined lands and by statistical comparisons of chemical data for wells in unmined areas with those for wells in mined areas. Comparisons between ground water isolated from sludge application sites and that near sludge application sites, within the same land type, indicate no changes attributable to sludge application.

ACKNOWLEDGMENTS

We wish to acknowledge the aid and encouragement of the Non-Federal Advisory Committee on Water Data for Public Use. Our special thanks go to the members of the Advisory Committee's Ad Hoc Working Group on River Quality Assessment. During the Willamette Study, the group included Howard B. Brown, Robert A. Canham, Edward J. Cleary, Laurence R. Jahn, John E. Kinney, Walter A. Lyon, John A. Roller, and Clarence J. Velz. The inspiration and insights of Clarence Velz were particularly helpful. Professor Charles E. Warren of the Department of Fisheries and Wildlife, Oregon State University, Corvallis, was instrumental in developing the "immediate environment" concept depicted in figure 1.